DIFFERENCES IN ROTATIONS BETWEEN THE WINNING AND LOSING TEAMS AT THE YOUTH EUROPEAN VOLLEYBALL CHAMPIONSHIPS FOR GIRLS

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BACKGROUND: Researchers of the game of volleyball often study the differences that separate the winning and losing teams. Namely, the volleyball game runs in two complexes (K1 – game after receive of serve: serve – receipt of serve – setting the attack – attack; K2 – game after own serve: serve – block – defence – counter attack), in addition the players have to rotate in accordance with the rules of the game of volleyball. Playing situations in six rotations do not equally correlate to K1 and K2 in their tactical aspect, nor are they of the same difficulty.

OBJECTIVES: The study examined whether there are statistically significant differences in the phases of a volleyball game between the winners and losers for each of the six volleyball rotations separately. Differences in individual rotations between winning and losing teams were examined. For rotations with statistically significant differences between the teams, the phases that determine those differences the most were also researched.

METHODS: The study was carried out at the European youth volleyball championships for women. Twenty games were analysed, a five level scale was used to evaluate the successfulness of the game for 98 under 18 years old women players. Six phases of the volleyball game were analysed: serve, receipt of serve, attack in K1, attack in K2, block and defence (attack receipt). A criterion variable was represented with each individual rotation. Simple descriptive statistical parameters were calculated together with six canonical discriminant analyses, one for each of the volleyball rotations.

RESULTS: The results of canonical discriminatory analysis revealed that four out of six volleyball rotations were statistically significant at the level of $p < 0.05$ (rotation 1 = 0.02; rotation 2 = 0.00; rotation 3 = 0.00; rotation 6 = 0.04). It is interesting to notice that different game phases show the largest projection of discriminatory function exactly in the rotations with statistically significant differences. They were: receipt of serve and attack in K1 and K2 for rotation 1, receipt of serve, block and defence for rotation 2, serve and defence for rotation 3, attack in K1 for rotation 6.

CONCLUSIONS: These results point to the specific characteristics of individual rotations in this age period, which have to be considered in the organisation of the training process. The results undoubtedly indicate that in the process of the synchronisation of team play, each of the six rotations require specific attention both in the technical and tactical sense.

Keywords: Volleyball, women, phases, successfulness of game.

INTRODUCTION

After the rules of volleyball game changed in 1999, the game experienced a complete renovation in the technical-tactical sense. Changes are obvious, particularly in the attack phase of the game. Analyses of major international competitions have revealed that attack combinations have become poorer (Ejem, 2001). Differences in the playing concepts of the teams from the past have become even larger (Frohner & Zimmermann, 2007). The majority of men's teams use a 5:1 system with identical positioning of players according to their playing positions, whereas switching the players in the attack phase from one zone to another is rare (Golf, 2008a; Yiannis & Panagiotis, 2005). This playing system and the specialisation of players are also being used in women's volleyball, although attacking female players more often switch playing positions in the attack phase (Munz, 2008). Most importantly, the differences in the statistical model of women's and men's teams are consistently decreasing (Golf, 2008b).

Researchers have tried in several ways to explain the differences between winning and losing teams. These explanations have been presented on the basis of morphological characteristics and motor abilities (Zadražnik, 1999; Stamm, 2004; Morrow, Jackson, Hosler, & Kachurik, 1979), whereas some researchers have used technical and tactical knowledge when interpreting the differences (Marelić, Rešetar, Zadražnik, & Đurković, 2005). All of the above mentioned characteristics result in a game lost or won through the number of points... Playing situations, which end in points lost or won, are,

as in all multi structural ball games, also in volleyball, very diverse and thus make the teams difficult to compare.

The rules of the game of volleyball demand, from highly specialised players, nevertheless a certain degree of universality in the technical-tactical sense, which coaches adjust to fit the characteristics and abilities of individuals and team tactics. Six rotations are given, in fact, with the majority of teams at the present time, using a 5:1 playing system, the positioning of players is made according to the following system: setter, diagonal player, two attackers – receivers of the serve, two blocking players and a libero. In technical language an individual rotation is determined according to the current position of the setter (in rotation 1 the setter is in zone 1; in rotation 2 the setter is in zone 2, etc.). The positioning of other players (blockers, attackers...) does not change between the elite teams. This fact allows for a comparison of the teams in certain rotational schemes. It has been previously found by Palao, Santos and Ureña (2005) that female setters are more efficient when the setter is situated in the back part of the field (zones 1, 5 and 6), whereas the efficiency of male attacking players is more balanced when the setter is situated in the front part of the field (zones 2, 3 and 4). Furthermore, some statistical packages (e.g. DataVolley) being used for the analysis of the success of a team or an individual play also provide information about the successfulness of the team (individual) in certain rotational schemes.

Information acquired through the statistical monitoring of matches is often used in studies. The analysis of the situational parameters of matches in team ball games is most often used to find the criterion or groups of criteria, which separate successful teams from unsuccessful ones (Eom & Schutz, 1992; Hughes & Daniel, 2003; Palao, Santos, & Ureña, 2004). In addition, previous research has aimed to find variables, which have had the largest individual correlation with the differences of the analysed parameters. For this purpose, the matches and the games are usually considered as entities, used for analysing the quality of the execution of monitored phases or volleyball skills. Criteria in such research are usually binary in nature, as they are focused on victory or defeat in a match or game (Zetou, Tsigilis, Moustakidisin, & Komninakidou, 2006).

One of the problems of such research lies in the selection of suitable ways for monitoring the volleyball matches (Hughes & Daniel, 2003). The amount of information collected, to a great extent, conditions the results of some multivariate methods. In practice, a few ways for monitoring the course of the matches have been established. In Europe, a statistical programme, DataVolley, is used most often by many clubs and national teams in order to analyse matches. Nevertheless, the data from matches, most desired by coaches and the International Volleyball Federation (FIVB), is that which could help with solving the practical problems of individual volleyball teams (Marelić, Rešetar, & Janković, 2004). In practice, coaches use reports of volleyball matches in order to analyse the game. These reports allow the coaches to find out in which rotations a team has been more or less efficient. This information is very important in the process of team synchronisation, also it can be used for research purposes. Đurković (2007) has attempted to find the differences in situational parameters and the successfulness of the game at the European youth volleyball championships for men by analysing six volleyball rotations. This method permitted an even more detailed explanation of the reasons for the successfulness of an individual volleyball team.

In the game of volleyball, winning or losing depends on a large number of factors. One of these factors is the efficiency necessary to solve technical-tactical situations – phases of the game. In addition, it is important for the success of the team that these phases are solved equally in all six rotations. This regularity depends on the balance of the playing quality in individual rotation; however statistical analyses of games reveal that such balance is difficult to achieve also in high quality teams. Some teams base their success on an efficient serve, others on the successful receipt of a serve and some yet again on an efficient attack... The aim of the present study is to utilise statistical data from the matches of the girls' youth teams in the sense of finding differences between the winning and losing teams. Nevertheless, in addition to identifying general differences between the teams, the game of winning and losing teams will be divided into six volleyball rotations in order to examine differences between these teams in individual rotations and to find the phases that best determine these differences.

METHODS

Data were collected at the European youth volleyball championships for women in Zagreb. Eight teams participated in the championships (Belarus, Croatia, Germany, Hungary, Italy, Poland, Russia, Serbia and Montenegro). The sample of measured subjects was represented with 98 female volleyball players in the youth category, all under the age of 18. Each team represented a separate entity. Twenty matches were played at the tournament and forty entities have been chosen for research purposes (situational parameters were recorded at each match for every team separately). Data used in the research have been collected with the use of the computer programme DataVolley Rel. 5.0, designed by the Dataproject Company.

Statistical monitoring of the matches is based on the evaluation of the successfulness of six phases of a vol-

leyball game – the situational parameters of the game (independent variables): SERVE (*SERVE*), RECEIPT OF SERVE (*RECEIPT*), ATTACK IN K1 after the receipt of serve (*ATTACK*), BLOCK (*BLOCK*), ATTACK RECEIPT (*DEFENCE*), ATTACK IN K2 after receipt of attack (*CATTACK*).

On the basis of the quality of execution, individual actions have been analysed within the six playing phases and placed on an ordinal five level scale: the lowest degree of execution on a scale (no. 1) represents an error (e.g. missed serve), whereas the highest degree of execution (no. 5) represents a point won (e.g. direct point from a serve) or else an optimum execution of a skill (e.g. optimum receipt of serve). The frequency of individual executions has been entered in a formula shown below and the coefficient of the execution for each individual phase has been calculated.

k = *(number of executions no. 1) × 1 + (number of executions no. 2) × 2 + (number of executions no. 3) × 3 + (number of executions no. 4) × 4 + (number of executions no. 5) × 5/total number of executions (executions no. 1 + executions no. 2 + executions no. 3 + executions no. 4 + executions no. 5)*

Calculation of the coefficient of the execution is one of the functions of the DataVolley programmes. It presents one of the possible calculations of the successfulness of a player in a game, a set, a part of the season, etc. For the purpose of the study, the coefficients of the

TABLE 1
Results of simple (descriptive) statistics of six rotations of a volleyball game

ROTATION1	M	Min	Max	SD	K–S
RECEIPT	3.90	2.92	4.67	0.43	0.069
SERVE	2.72	2.13	3.45	0.28	0.070
DEFENCE	3.11	1.50	4.43	0.68	0.139
BLOCK	2.78	1.33	4.67	0.70	0.092
ATTACK	3.79	2.67	5.00	0.60	0.082
CATTACK	3.65	1.00	4.71	0.58	0.143

ROTATION4	M	Min	Max	SD	K–S
RECEIPT	3.78	2.40	5.00	0.51	0.084
SERVE	2.61	1.86	3.43	0.39	0.073
DEFENCE	3.21	2.00	4.50	0.59	0.080
BLOCK	2.77	1.00	4.33	0.69	0.125
ATTACK	3.69	2.67	4.50	0.45	0.104
CATTACK	3.45	1.00	4.75	0.70	0.133

ROTATION2	M	Min	Max	SD	K–S
RECEIPT	3.92	3.00	5.00	0.51	0.104
SERVE	2.71	2.00	3.57	0.35	0.081
DEFENCE	3.36	2.20	5.00	0.68	0.111
BLOCK	2.51	1.00	4.33	0.88	0.093
ATTACK	3.78	2.91	4.67	0.46	0.094
CATTACK	3.70	2.25	5.00	0.72	0.114

ROTATION5	M	Min	Max	SD	K–S
RECEIPT	3.87	2.71	5.00	0.60	0.078
SERVE	2.62	2.11	3.29	0.29	0.137
DEFENCE	3.00	0.00	4.25	0.82	0.130
BLOCK	2.49	0.00	5.00	1.07	0.097
ATTACK	3.86	2.22	5.00	0.52	0.082
CATTACK	3.49	1.33	4.63	0.72	0.102

ROTATION3	M	Min	Max	SD	K–S
RECEIPT	3.86	3.00	4.75	0.46	0.092
SERVE	2.74	1.50	3.22	0.35	0.136
DEFENCE	3.14	1.33	5.00	0.87	0.112
BLOCK	2.76	1.00	5.00	0.82	0.097
ATTACK	3.67	2.67	5.00	0.54	0.101
CATTACK	3.78	2.17	5.00	0.59	0.09

ROTATION6	M	Min	Max	SD	K–S
RECEIPT	4.06	3.07	4.75	0.41	0.108
SERVE	2.64	2.00	3.55	0.39	0.058
DEFENCE	2.95	1.00	5.00	0.82	0.112
BLOCK	2.82	1.00	4.00	0.71	0.148
ATTACK	3.85	2.80	4.75	0.52	0.121
CATTACK	3.70	0.00	4.83	0.81	0.177

Legend:
M – average
Min – minimal result
Max – maximal result
SD – standard deviation
K–S – Kolmogor-Smirnov test of the normality of distribution of results
RECEIPT – receive of serve
SERVE – serve
DEFENCE – receive of attack
BLOCK – block
ATTACK – attack in K1
CATTACK – attack in K2
ROTATION 1, 2... 6 – position of the setter in the field

execution were calculated for all six playing phases and for both winning and losing teams for each rotation.

Individual rotations represented a criterion variable, which is of binary nature (winning or losing the match) and undoubtedly depends on the quality of the execution of individual phases of a game of volleyball (serve, receipt of serve, attack in K1 or K2, etc.). In the first phase, individual rotations were compared (rotation 1, rotation 2..., rotation 6 of the winning and losing teams) and whether there are statistically significant differences between the rotations was examined. It has been speculated that statistically significant differences between the winning and losing teams will be revealed in some of the rotations. Therefore, the second part of the study examined the phases of a volleyball game (serve, receipt of serve, block...), which in large part determine the winning and the losing teams for each of the rotations, with statistically significant differences between the teams. As the balance of individual rotations is hard to guarantee even in higher age categories, it has been assumed that in different rotations different phases of the volleyball game will influence the result of the game and their influence will be of various significance.

The data of games played have first been entered in the computer and analysed with the use of the Statistica for Windows version 5.0 programme, and, afterwards, simple descriptive parameters were calculated. In the module *Discriminant analysis* from the programme, a canonical discriminant analysis has been used in order to calculate six analyses, one for each of the volleyball rotations.

RESULTS

TABLE 1 shows the results of simple descriptive statistics, calculated for each of the six volleyball rotations separately. Arithmetic mean, minimum and maximum values as well as the standard deviation have been calculated for all six game phases. The normality of the distribution of data has been tested with the Kolmogor-Smirnov test. The critical value of n = 20 on the level of statistical significance (p) 0.01 was 0.294. Results in the table show that all the variables were normally distributed.

TABLE 2 shows the results of six canonical discriminatory analyses, one for each of six volleyball rotations. Their own values (λ), canonical correlations (R), chi-square values (χ^2), the number of degrees of freedom (df) and the level of the significance of discriminatory functions (p) have been calculated for all six rotations. Values were obtained with the use of a standard method of discriminatory function. The results reveal statistically significant differences in selected situational parameters of the game between the groups of winning and losing teams in rotations 1, 2, 3 and 6.

TABLE 2
Results of six discriminant analyses

	λ	R	χ^2	df	p
ROTATION 1	0.49	0.57	14.05	6	0.02
ROTATION 2	0.67	0.63	17.98	6	0.00
ROTATION 3	0.93	0.69	22.48	6	0.00
ROTATION 4	0.29	0.47	9.09	6	0.16
ROTATION 5	0.40	0.53	11.85	6	0.06
ROTATION 6	0.44	0.55	13.00	6	0.04

Legend:
λ – own values
R – canonical correlation
χ^2 – chi-square test
df – number of degrees of freedom
p – level of characteristics of discriminatory function in six rotations
ROTATION 1, 2...6 – position of the setter in the field

TABLE 3
Correlation between variables and discriminant functions and the position of group centroids)

	Discriminant function			
VARIABLE	**ROTATION 1**	**ROTATION 2**	**ROTATION 3**	**ROTATION 6**
RECEIPT	0.79	0.53	0.07	0.34
SERVE	0.22	–0.18	0.74	0.13
DEFENCE	–0.03	0.54	0.57	0.24
BLOCK	0.30	0.71	0.36	0.34
ATTACK	0.53	0.19	0.40	0.63
CATTACK	0.55	0.33	0.20	0.06
	GROUP CENTROIDS			
LOSING TEAMS	–0.68	–0.79	–0.96	–0.65
WINNING TEAMS	0.68	0.79	0.91	0.65

Legend:
RECEIPT – receive of serve
SERVE – serve
DEFENCE – receive of attack
BLOCK – block
ATTACK – attack in K1
CATTACK – attack in K2
ROTATION 1, 2, 3 and 6 – position of the setter in the field

The results in TABLE 3 reveal the largest projection of discriminatory function in the first rotation (ROTATION 1) in the receipt of the serve (RECEIPT = 0.79), followed by the attack in K2 (CATTACK = 0.55) and the attack in K1 (ATTACK = 0.55). In rotation 2 (RO-

TATION 2) there was also good receipt of service (RECEIPT = 0.53), there also has been a block of key importance (BLOCK = 0.71) and defence (DEFENCE = 0.54). In rotation 3 (ROTATION 3), as having the largest influence of the variables, service (SERVE = 0.74) and defence (DEFENCE = 0.57) have been revealed. In rotation 6 (ROTATION 6), the variable attack in K1 (ATTACK = 0.63) was shown to have had the greatest influence.

DISCUSSION

The review of the results of all six rotations revealed the highest average values for the variables: receipt of serve (RECEIPT), attack in K1 (ATTACK) and attack in K2 (CATTACK). These results correspond to the data about the statistical game model from major volleyball competitions (Golf, 2008a; Golf, 2008b; Match Info, 2009a; Match Info, 2009b), showing that the majority of points in volleyball are won in attack. Furthermore, the successfulness in the variable receipt of service is significantly higher in comparison to other technical elements. Further, the procedure of multivariate analysis was used in order to separate those game phases within every rotation, which show any statistically significant difference between the group of winning and losing teams.

From the values shown in TABLE 2 it can be concluded that the results of discriminatory analysis revealed statistically significant differences between the winning and losing teams ($p < 0.05$) in four out of six rotations: Rotation 1, Rotation 2, Rotation 3 and in Rotation 6. The structure of discriminatory function was bipolar. The group of winning teams has been placed on a positive pole, whereas the group of losing teams has been placed on a negative pole. It is interesting to notice that statistically significant differences have not been seen in rotations 4 and 5. Namely, in these rotations the setter has the most difficult task in the organisation of the attack in complex 1 (K1). After the opponent's serve, the setter has the longest distance to travel to the optimal position for setting the attack (between zones 2 and 3); the player also has to turn towards zone 4 during this transition and as a result momentarily loses visual contact with the ball. As a result, it could be concluded that the game in these two rotations is less diverse and more predictable, although it is possible that the teams from the sample did not have extraordinary setters, who could solve technical-tactical situations in these rotations more successfully.

All the analysed teams played according to the system of 5–1, meaning that one player is in the role of setter – she organises the game and sets the ball in attacks (K1) and counter attacks (K2) in all six rotations. In the first and sixth rotation ($p = 0.02$ and $p = 0.04$), the setter is situated at the back part of the volleyball court, whereas in the second and third rotation ($p = 0.00$ in $p = 0.00$) she is situated by the net. Situations when the setter is at the net with only two attacking players nearby, is, in the tactical sense, considerably different from the situation when she is at the back of the court with three available attacking players at the net. Theoretically speaking it is easier to organise an attack when the setter is at the back part of the court and running into an empty space at the net. In addition to the three nearby attacking players at the net, she can use at least one of the back court attackers as well. It also needs to be mentioned that the setters are usually the worst blocking players in the game.

The highest statistically significant values of canonical correlation (R) have been noticed in the two rotations (Rotation 3 and 2), when the setter is at the net. It can be assumed that the winning teams managed to attack more successfully from the back part of the court. Additionally, it needs to be considered that the winning teams have been shown to be more efficient in servicee and blocking in these rotations.

Đurković (2007) has, based on the sample of male players of the same age category, found out that discriminatory functions significantly differentiate the groups of teams, ranked on the basis of placement at the tournament, at the significance level 0.01 ($p < 0.01$) in rotations 5 and 3. Rotation 5 in K1 is very unfavourable for a setter, as he or she has to come to the point of the attack organisation from the left side of the net and is required to travel the longest distance. It is also possible that in rotation 3 the strong serve of a diagonal player (presumably a jump serve) creates a playing situation that often leads to the winning of the point. In the same research paper, Đurković gives us a sample of youth male players' individually analysed rotations with the setter at the net. With the use of discriminatory analysis, he presented the contribution of statistically significant differences in situational parameters to the benefit of winning teams. Better placed teams have also served better and played more successfully in the third rotation and the complex 1 (K1): receipt of serve – setting the attack – attack.

It can be assumed that the similar results of the winning teams in the category of youth female players and their successfulness in third rotations are a consequence of the jump serve and the attack of the diagonal player from the second line. Empirically speaking, it is obvious that the majority of innovations in technique and tactics began in men's volleyball. Nevertheless, the game of female youth players shows itself to be a successful copy of the game systems, techniques and tactics of the male game model.

Interesting are also the results of correlation variables (TABLE 3) with discriminatory function and the position of centroid groups in this function in rotations, which are statistically significant at the level $p < 0.05$.

A particularly interesting feature of the present research findings is also that the results of multivariate analysis confirmed four statistically significant rotations, which discriminate winning and losing teams. Within these rotations, different game phases differently influence a criterion variable, i.e. victory or defeat.

In rotation 1, the setter runs in from the second line, also in the analysed rotations of female youth players. In this rotation, a quality receipt of the serve has the largest effect on the successfulness of the team, allowing the winning team to launch a diverse attack, which opponents find difficult to block and this results in a poor defence. Even when the defence is successful, teams then have difficulties in organising an attack. The result of such an attack is also that the team receiving the serve, has an easier time of it and more often achieves a point in the counter attack. It is interesting to notice that the high values of a variable CATTACK are not the result of a better defence game (DEFENCE = 0.03), which is a prerequisite for a successful counter attack game. It can be assumed that the individual quality of attacking players in the winning teams has enabled an efficient attack game even after the worst defence.

The results of rotation 2 partly negate the stated argument that setters are usually worse blockers. Winning teams presumably can be differentiated from losing teams in this rotation in the diverse attack. In the case of worse teams not launching an efficient attack from zone 1, then the work of blocking players is much easier in the modern game of volleyball. Namely, three blocking players monitor the attack of two attackers at the net. If the opponent directs the ball to pass the set block, then the defensive players also have a chance to save the ball when the block has been set in time.

In rotation 3, when a setter is at the central position at the net, the serve (SERVE = 0.74) and the receipt of serve (DEFENCE = 0.57) most significantly contribute to the differences between the analysed groups. In this rotation, a diagonal player serves, usually with the use of a jump serve. This serve usually allows a timed position of the blocking players and consequently better chances for the defending players.

In the last, sixth rotation, an attack after the receipt of a serve reveals a high correlation with the criterion of ATTACK = 0.63. Domination in the attack after the receipt of serve (K1) confirms our understanding that, in modern volleyball, it is important not to lose points in complex 1, i.e. in actions immediately after receiving the serve. Apparently, the winning teams are much more efficient in this element of the game. Elite volleyball, as opposed to tennis, favours the advantage of the team receiving the serve and delivering the attack, not the team that serves.

Presumably the majority of volleyball coaches will agree with this argument, nevertheless, the results of other rotations show that in practice this is not easily achieved.

CONCLUSIONS

It has been confirmed that, in the youth category, there exist differences between the winning and losing teams in the quality of the execution of various phases of the volleyball game, even when the teams are at such a high level as the European championships. The results of descriptive statistics have revealed, on the basis of the calculation methodology of the coefficient of the execution, the highest values of variables that in the game of volleyball possess a high degree of efficiency and frequency of use (ATTACK, CATTACK, RECIVE).

An analysis of situational parameters in six volleyball rotations has revealed statistically significant differences between the teams in four rotations (ROTATION 1, 2, 3 in 6). It has been found that these are the rotations, where the setter has an easier path to the position of the attack organisation. It can be assumed that teams in this category already differentiate in the quality of attack from behind the 3 metre line. Additionally, it has been revealed that in the rotations with statistically significant differences, various phases of the volleyball game (serve, receipt of serve...) determine these differences.

The results indicate the specific character of individual rotations for this age category, which has to be considered when managing the training process. The findings need to be included in the process of team synchronisation; each of the six rotations requires particular attention both in the technical and tactical sense.

In conclusion, it springs to mind that a comparative analysis of situational parameters in women's volleyball will need to be carried out for the situations when the setter is at the net (rotation 2, 3 and 4) and the situations when the setter is in the field (rotations 1, 5 and 6). This differentiation would pinpoint the effects of individual playing positions in the rotations more precisely. Similarly, it would be interesting to analyse rotations in junior and senior categories, keeping in mind the same aim and methods in order to find out whether differences would reoccur. The training process and a perfection of knowledge in the technical and tactical sense can cause differences between the teams, although it is possible that the difference found would only increase. Nevertheless, it has to be understood that a number of various factors influence the result of the match and that the quality of a game in individual rotation is merely one of them. Therefore, a generalisation of the findings

of the present study is questionable without further research.

REFERENCES

Đurković, T. (2007). An analysis of the effects of situational parameters on the game efficiency of rotations at the Youth EC in volleyball for men. Master's thesis, University of Zagreb, Faculty of Kinesiology, Zagreb.

Ejem, M. (2001). A brief technical evaluation of the 27th Olympiad in Sydney. *The Coach, 1,* 6–12.

Eom, H. J., & Schutz, R. W. (1992). Statistical analyses of volleyball team performance. *Research Quarterly for Exercise and Sport, 63,* 11–18.

Frohner, B., & Zimmermann, B. (2007). So sehen Sieger aus. *Volleyball Magazin, 3,* 21–25.

Golf, B. (2008a). Olympia analyse. *Volleyball magazine, 1,* 21–27.

Golf, B. (2008b). Olympia analyse. *Volleyball magazine, 10,* 14–16.

Hughes, M., & Daniel, R. (2003). Playing patterns of elite and non elite volleyball. *International Journal of Performance Analysis in Sport, 3(1),* 50–56.

Marelić, N., Rešetar, T., & Janković V. (2004). Discriminant analysis of the sets won and the sets lost by one team in the A1 Italian volleyball league: A case study. *Kinesiology - International Journal of Fundamental and Applied Kinesiology, 36(1),* 75–82.

Marelič, N., Rešetar, T., Zadražnik, M., & Đurković, T., (2005). Modelling of situation parameters in top level volleyball. In D. Milanović & F. Prot (Eds.), *Proceedings book of the 4th International Scientific Conference on Kinesiology "Science and profession: A challenge for the future"* (p. 459–464). Zagreb: University of Zagreb.

Match Info. (2009a). *FIVB.* Retrieved 28. 9. 2009 from the World Wide Web: http://www.fivb.org/EN/Volleyball/Competitions/Olympics/2008/W/Press/MatchInfo.asp

Match Info. (2009b). *FIVB.* Retrieved 28. 9. 2009 from the World Wide Web: http://www.fivb.org/EN/Volleyball/Competitions/Olympics/2008/M/Press/MatchInfo.asp

Morrow, J. R., Jackson, A. S., Hosler, W. W., & Kachurik, J. K. (1979). The importance of strength, speed and body size for team success in women's intercollegiate volleyball. *Research Quarterly for Exercise and Sport, 50(3),* 429–437.

Munz, M. (2008). Olympia analyse. *Volleyball magazine, 12,* 17–23.

Palao, J. M., Santos, J. A., & Ureña, A. (2004). Effect of team level on skill performance in volleyball. *International Journal of Performance Analysis in Sport, 4(2),* 50–60.

Palao, J. M., Santos, J. A., & Ureña, A. (2005). The effect of the setter's position on the spike in volleyball. *Journal of Human Movement Studies, 48(1),* 25–40.

Stamm, R. (2004). Body build structure of young female volleyballers (aged 13–16) and their performance in competition. *Manking Quarterly, 44(3–4),* 253–273.

Yiannis, L., & Panagiotis, K. (2005). Evolution in men's volleyball skills and tactics as evidenced in the Athens 2004 Olympic Games. *International Journal of Performance Analysis in Sport, 5(2),* 1–8.

Zadražnik, M. (1999). Assessing competitive and potential successfulness of advanced young volleyball players. *Kinesiologia Slovenica, 5(1/2),* 45–50.

Zetou, E., Tsigilis, N., Moustakidis, A., & Komninakidou, A. (2006). Playing characteristics of men's Olympic volleyball teams in complex II. *International Journal of Performance Analysis in Sport, 6(1),* 172–177.

ZMĚNY V ROTACÍCH MEZI VYHRÁVAJÍCÍMI A PROHRÁVAJÍCÍMI TÝMY NA JUNIORSKÝCH MISTROVSTVÍCH EVROPY VE VOLEJBALU DÍVEK

(Souhrn anglického textu)

VÝCHODISKA: Lidé zkoumající volejbal často sledují rozdíly, jež odlišují vyhrávající a prohrávající týmy. Volejbalový zápas totiž probíhá ve dvou celcích (K1 – hra po příjmu podání: podání – příjem podání – příprava útoku – útok; K2 – hra po vlastním podání: podání – blok – obrana – protiútok), a navíc hráči musejí rotovat v souladu s pravidly volejbalové hry. Herní situace v šesti rotacích stejnou měrou neodpovídají K1 a K2, pokud jde o taktické záměry, ani nemají stejnou obtížnost.

CÍLE: Studie zkoumala, zda existují statisticky významné rozdíly v jednotlivých fázích volejbalového zápasu mezi vyhrávajícími a prohrávajícími týmy, a to samostatně pro všech šest rotací. Zkoumaly se rozdíly mezi jednotlivými rotacemi mezi vyhrávajícími a prohrávajícími týmy. U rotací se statisticky významnými rozdíly mezi týmy se také zkoumaly ty fáze, jež nejvíce rozhodují o těchto rozdílech.

METODY: Studie byla prováděna v rámci juniorských mistrovství Evropy ve volejbalu žen. Bylo analyzováno dvacet zápasů, v rámci této analýzy byla použita pětistupňová škála hodnotící úspěšnost hry 98 hráček mladších 18 let. Bylo analyzováno šest fází volejbalového zápasu: podání, příjem podání, útok v rámci K1, útok v rámci K2, blok a obrana (příjem útoku). U každé jednotlivé rotace byla stanovena kriteriální proměnná. Byly vypočteny prosté deskriptivní statistické parametry

společně se šesti kanonickými diskriminačními analýzami (jedna pro každou rotaci).

VÝSLEDKY: Výsledky kanonické diskriminační analýzy ukázaly, že čtyři ze šesti rotací byly statisticky významné na úrovni $p < 0,05$ (rotace 1 = 0,02; rotace 2 = 0,00; rotace 3 = 0,00; rotace 6 = 0,04). Je zajímavé povšimnout si, že různé fáze zápasu vykazují největší projekci diskriminační funkce přesně v rotacích se statisticky významnými rozdíly. Těmi byly: příjem podání a útok v rámci K1 a K2 u rotace 1, příjem podání, blok a obrana u rotace 2, příjem a obrana u rotace 3, útok v rámci K1 u rotace 6.

ZÁVĚRY: Tyto výsledky ukazují na specifické charakteristiky jednotlivých rotací v této věkové skupině, jež je třeba vzít do úvahy v rámci organizace tréninku. Výsledky nepochybně indikují, že v průběhu synchronizace týmové hry každá ze šesti rotací vyžaduje zvláštní pozornost, a to pokud jde o techniku i taktiku.

Klíčová slova: volejbal, ženy, fáze, úspěšnost hry.

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Education and previous work experience

After finishing undergraduate studies at the Faculty of Sport at the University of Ljubljana, he turned to work in private sector in 1984. Taught physical education at a high school for civil engineering until 1986, then took up a post as an assistant professor of volleyball programme at the Faculty of Sport, where he has finished postgraduate masters degree in 1994 and Ph.D. in 1998.

Scientific orientation

In the scientific field, he is mainly researching and examining the factors of success in volleyball. In the expert field, he is concentrating on education and training of professional workforce in volleyball (he has run or participated in more than 100 courses or seminars on the topic of volleyball). He is an author of several books and course manuals. Before ending his career as a coach in 2006, he has successfully led several Slovenian club teams in various age categories as well as national selections. He is a president of the Expert Council at the Volleyball Federation of Slovenia.

First-line publication

Zadražnik, M. (1999). Assessing competitive and potential successfulness of advanced young volleyball players. *Kinesiol. Slov., 5(1/2),* 45–50.

Zadražnik, M. (1995). Ermittlung der Unterschide bei den motorischen und morphologischen Dimensionen Jugendlicher, auf verschiedenen Spielpositionen eingesetzter Volleyball-Spier. In J. Bergier (Ed.), *An international conference on science in sports team games* (pp. 307–315). Biala Podlaska: Instytut Wychowania Fizycznego i Sportu.

Zadražnik, M. (1999). Spremljanje razvoja nekaterih morfoloških in motoričnih razsežnosti, pomembnih za uspešnost odbojkarja, od 7. do 16. leta. In E. Hofmann (Ed.), *Proceedings Školski sport* (pp. 363–367). Zagreb: Fakultet za fizičku kulturu.

Zadražnik, M. (2002). Reliability and objectivity of evaluating practical knowledge of volleyball in physical education. In R. Pišot, V. Štemberger, F. Krpač, & T. Filipčič (Eds.), *Proceedings Otrok v gibanju* (pp. 415–420). Ljubljana: Pedagoška fakulteta.